

[SPECIFICATION]

[TITLE OF THE INVENTION]

**LIQUID CRYSTAL DISPLAY DEVICE AND METHOD FOR FABRICATING
THE SAME**

[BRIEF DESCRIPTION OF THE DRAWINGS]

FIGs 1a to 1e are section views illustrating a conventional method for fabricating a liquid crystal display (LCD) device

FIG. 2 is a cross-sectional view illustrating a conventional LCD device employing a 6 mask.

FIG. 3 is a cross-sectional view illustrating an LCD device according to an embodiment of the present invention.

FIGs. 4a to 4e are cross-sectional views illustrating a method of fabricating the LCD device of FIG. 3.

<DESCRIPTION OF THE SYMBOLS IN MAIN PORTIONS OF THE DRAWINGS>

10, 32: Transparent substrate	12, 34: Gate electrode
14, 36: Gate pad	16, 38: Gate insulating film
18, 40: Active layer	20, 42: Ohmic contact layer
22, 44: Source electrode	24, 46: Drain electrode
26, 48: Passivation layer	28, 52: Pixel electrode
30, 54: Transparent electrode	50: Alloy layer

[DETAILED DESCRIPTION OF THE PRESENT INVENTION]

[OBJECT OF THE PRESENT INVENTION]

[FIELD OF THE INVENTION AND DESCRIPTION OF THE RELATED ART]

The present invention relates to a liquid crystal display (LCD) device and a method for manufacturing the LCD device, and more particularly, to an LCD device capable of decreasing a contact resistance between a single metal layer having a

good conductivity and a transparent electrode, and a method for manufacturing the LCD device.

LCD devices control light transmissivity of liquid crystal cells in response to video signals to display an image. Active matrix LCD devices having a switching device for each liquid crystal cell is suitable for displaying moving pictures. In active matrix LCD devices, thin film transistors (TFTs) are typically used as the switching device.

For example, an LCD device may include thin film transistors (TFTs) provided at each intersection between gate lines and data lines, a lower substrate including pixel electrodes connected to TFTs, an upper substrate including color filters, and liquid crystals injected between the upper and lower substrates. The TFT comprises a gate electrode, a gate insulating film, an active layer, and source and drain electrodes and switches a data signal from one of the data lines to one of the pixel electrodes in response to a gate signal received from one of the gate lines to drive the liquid crystal cell.

FIGs. 1a to 1e illustrate a method for fabricating a conventional LCD device, in particular, a TFT and a gate pad portion.

Referring to FIG. 1a, a metal layer is deposited onto a transparent substrate 10 to have a thickness of about 2000Å by a sputtering process. Al alloy such as aluminum-neodymium (AlNd) is usually used as the metal layer. Subsequently, the metal layer is patterned by photolithographic and wet etching processes to form a gate line, a gate electrode 12, and a gate pad 14.

Referring to FIG. 1b, a gate insulating film 16 is formed on the transparent substrate 10 to cover the gate line, the gate electrode 12, and the gate pad 14. An active layer 18 and an ohmic contact layer 20 are sequentially deposited on the gate insulating film 16 using a chemical vapor deposition (CVD) process. Then, the active layer 18 and the ohmic contact layer 20 are patterned. The gate insulating film 16 is formed of an insulating material such as silicon oxide or silicon nitride. The active layer 18 is formed of amorphous silicon or polycrystalline silicon, which is not doped with impurities. The ohmic contact layer 20 is formed of amorphous

silicon or polycrystalline silicon, which is heavily doped with an N-type impurity or a P-type impurity.

Referring to FIG. 1c, an ohmic metal layer 30 is formed on the ohmic contact layer 20 using a CVD process or a sputtering process. The ohmic metal layer 30 is formed of a metal such as chrome (Cr), molybdenum (Mo), titanium (Ti), or tantalum (Ta), or molybdenum alloy such as molybdenum-tungsten (MoW), molybdenum-tantalum (MoTa), or molybdenum-niobium (MoNb). The ohmic metal layer 30 is ohmic-contacted with the ohmic contact layer 20.

The ohmic metal layer 30 and the ohmic contact layer 20 are sequentially patterned using a photolithographic process to expose the active layer 18. The ohmic metal layer 30 is patterned to form a source electrode 22, a drain electrode 24, and a data line (not shown) that is perpendicular to the data line (not shown). The source electrode 22 and the drain electrode 24 respond to the gate electrode 12.

Referring to FIG. 1d, a passivation layer 26 is formed on the active layer 18 to cover the source electrode 22, the drain electrode 24, and the ohmic contact layer 20. The passivation layer 26 is formed of an inorganic material such as silicon nitride or silicon oxide or may be formed of an organic material such as an acrylic organic compound, BCB (benzocyclobutene), or PFCB (perfluorocyclobutane). The passivation layer 26 is patterned to form a contact hole exposing the drain electrode 24 and to form a contact hole exposing the gate pad 14 and a data pad (not shown).

Referring to FIG. 1e, a transparent electrode 28 is formed on the gate insulating film 16 and the passivation layer 26 except for a portion responding to the TFT. The transparent electrode 28 is formed of indium-tin-oxide (ITO), which is a transparent conductive material.

The conventional LCD device utilizes an Al-based metal having a good conductivity as a metal electrode. Particularly, AlNd is used to solve a problem such as hillock and diffusion of Al. However, the Al based metal has a great contact resistance with respect to the transparent electrode such as a pixel electrode and a passivation electrode. Accordingly, referring to FIG. 2, a metal electrode utilizes a double metal layer structure including material combinations such as Mo/AlNd, Mo/Al,

and Cr/AlNd containing Mo or Cr. Mo or Cr improves a contact resistance with respect to materials used for forming the transparent electrode. However, since the metal electrode layer having the double metal layer structure requires two etching processes, yields ratios are decreased, and manufacturing costs are increased.

[TECHNICAL OBJECT OF THE INVENTION]

An object of the present invention is to provide a liquid crystal display device capable of decreasing a contact resistance between a single metal electrode layer and a transparent electrode, and a method for manufacturing the same.

[CONSTITUTION AND OPERATION OF THE INVENTION]

According to an aspect of the present invention, there is provided a liquid crystal display device including a signal line, wherein the signal line includes: a substrate; a first metal layer formed on the substrate; an alloy layer formed on the first metal layer; an insulating film having a hole on the alloy layer; and an electrode contacting the alloy layer through the hole of the insulating film.

According to another aspect of the present invention, there is provided a method for manufacturing a liquid crystal display device, the method including; forming a first metal layer on a substrate; depositing a second metal layer directly on the first metal layer so as to allow an alloy layer including materials of the first and second metal layers to be formed between the first and second layers; removing the second metal layer remaining on the alloy layer; etching the first metal layer in a predetermined pattern; forming an insulating film including a hole on the alloy layer; and forming an electrode contacting the alloy layer through the hole.

Reference will now be made in detail to the embodiments of the present disclosure, examples of which are illustrated in the accompanying drawings.

FIG. 3 is a cross-sectional view illustrating an LCD device, and particularly, a TFT and a gate pad portion, according to an embodiment of the present invention. Referring to FIG. 3, a first metal layer for metal electrodes 34 and 36 and a second metal layer formed of any one of molybdenum (Mo) and chrome (Cr) are sequentially

formed on a transparent substrate 32 of the LCD device according to the embodiment of the present invention. The first metal layer is formed of Al alloy such as AlNd. A chemical reaction occurs between the first and second metal layers by heat generated during the forming of the second metal layer. An alloy layer 50 of the Al alloy and any one of molybdenum and chrome is formed between the first and second layers. A contact resistance with respect to the transparent electrode can be decreased by the alloy layer 50 and a metal layer formed of a single Al-based material having a good conductivity used for lines and electrodes.

FIGs. 4a to 4e are cross-sectional views illustrating a method for fabricating an LCD device, and particularly, a TFT and a gate pad portion, according to an embodiment of the present invention.

Referring to FIG. 4a, a first metal layer is formed on a transparent substrate 32 using a sputtering process. The metal layer is formed of Al alloy such as AlNd and has a thickness ranging from about 2000 Å to about 3000 Å, preferably a thickness of about 2500 Å. Subsequently, a second metal layer formed of a metal material such as molybdenum or chrome is formed on the first metal layer to have a thickness ranging from about 100 Å to about 500 Å, preferably a thickness of about 300 Å. A chemical reaction occurs between the Al alloy and the metal material such as molybdenum or chrome by heat generated during the forming of the second metal layer. An alloy layer 50 of the Al alloy and the metal material such as molybdenum or chrome is formed between the Al alloy and the metal material such as molybdenum or chrome. Then, the second metal layer is removed by a dry etching process. Sequentially, the first metal layer and the alloy layer are patterned using photolithographic and wet etching processes, thereby forming a gate line (not shown), a gate electrode 34 and a gate pad 36 on predetermined portions of the transparent substrate 32.

Referring to FIG. 4b, a gate insulating film 38 is formed on the transparent

substrate 32 to cover the gate line, the gate electrode 34 and the gate pad 36. After that, an active layer 40 and an ohmic contact layer 42 are sequentially deposited on the gate insulating film 38 by a chemical vapor deposition (CVD) process and are then patterned. The gate insulating film 38 is formed of an insulator such as silicon oxide or silicon nitride, and the active layer 40 is formed of amorphous silicon or polycrystalline silicon. The ohmic contact layer 42 is formed of amorphous silicon or polycrystalline silicon, which are heavily doped with an N-type impurity or a P-type impurity.

Referring to FIG. 4c, an ohmic metal layer is formed on the ohmic contact layer 42 using a CVD process or a sputtering process. The ohmic metal layer 30 is formed of a metal such as chrome (Cr), molybdenum (Mo), titanium (Ti), or tantalum (Ta), or molybdenum alloy such as molybdenum-tungsten (MoW), molybdenum-tantalum (MoTa), or molybdenum-niobium (MoNb). The ohmic metal layer is ohmic-contacted with the ohmic contact layer 42.

The ohmic metal layer and the ohmic contact layer 42 are sequentially patterned using a photolithographic process to expose the active layer 40. The ohmic metal layer is patterned to form a source electrode 44, a drain electrode 46, and a data line (not shown) that is perpendicular to the data line (not shown). The source electrode 44 and the drain electrode 46 respond to the gate electrode 34.

Referring to FIG. 4d, a passivation layer 48 is formed on the active layer 40 to cover the source electrode 44, the drain electrode 46, and the ohmic contact layer 42. The passivation layer 48 is formed of an inorganic material such as silicon nitride or silicon oxide or may be formed of an organic material such as an acrylic organic compound, BCB (benzocyclobutene), or PFCB (perfluorocyclobutane). The passivation layer 48 is patterned to form a contact hole exposing the drain electrode 46 and to form a contact hole exposing the gate pad 36 and a data pad (not shown).

Referring to FIG. 4e, transparent electrodes 52 and 54 are formed on the gate insulating film 38 and the passivation layer 48 except for a portion responding to the TFT. The transparent electrodes 52, 54 are formed of indium-tin-oxide (ITO), which is a transparent conductive material.

Accordingly, in the LCD device and the method for using the same according to the embodiments of the present invention, the low resistance metal such as molybdenum or chrome is subsequently formed on the metal electrode formed of the Al alloy. The alloy layer is formed between the metal electrode and the low resistance metal by heat generated during the formation of the low resistance metal. Then, the low resistance metal is removed by the dry etching process to expose the alloy layer. Thereafter, a pixel electrode is formed to contact the alloy layer.

[EFFECT OF THE INVENTION]

As described above, in the LCD device and the method for using the same according to the embodiments of the present invention, when the metal electrode and the low resistance metal are sequentially formed on the transparent substrate, the alloy layer is formed between the metal electrode and the low resistance metal. Then, the low resistance metal is removed to expose the alloy layer, and the transparent electrode is formed to contact the alloy layer. Accordingly, a decreased electrical contact resistance between the electrode metal layer and the transparent electrode is obtained. Moreover, since fewer masking steps are used compared with those of a conventional LCD device employing double metal layers, yields ratios and manufacturing costs are improved.

It will be apparent to those skilled in the art that various modifications and variations can be made in the liquid crystal display and method thereof of the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.